What is claimed is:

1. A composite structure in which a structure made of a brittle material such as a ceramic or a metalloid formed on a substrate surface is provided, characterized in that the structure is polycrystalline and crystals forming the structure do not substantially exhibit crystal orientation, wherein a boundary layer made of hyaline does not substantially exist on a boundary face between crystals and part of the structure is an anchor section biting into the substrate surface.

2. The composite structure according to claim 1, wherein the crystals forming the structure do not involve grain growth by heat.

3. The composite structure according to claim 1, wherein the average crystallite size of the structure is 500 nm or less and the compactness thereof is 70% or more.

4. The composite structure according to claim 1, wherein the average crystallite size of the structure is 100 nm or less and the compactness thereof is 95% or more.

5. The composite structure according to claim 1, wherein the average crystallite size of the structure is 50 nm or less and the compactness thereof is 99% or more.

6. The composite structure according to claim 1, wherein the aspect ratio of the crystals forming the structure is 2.0 or less.

7. The composite structure according to claim 1, wherein elements other than main elements forming the crystals do not segregate on the boundary face of the crystals forming the structure.

8. The composite structure according to claim 1, wherein there is a nonstoichiometric deficiency near the boundary face of the crystals forming the structure.

9. The composite structure according to claim 8, wherein the crystals are metallic oxides and the nonstoichiometric deficiency exhibits nonstoichiometry based on an oxygen deficiency.

10. The composite structure according to any one of claims 1 through 9, wherein the substrate is glass, metal, ceramics or an organic compound.

11. A composite structure forming method comprising, after performing a step of

creating internal strain in brittle material fine particles, the steps of:

causing the brittle material fine particles in which the internal strain has been created to collide with a substrate surface at high speed;

deforming or fracturing the brittle material fine particles by the impact of this collision;

rejoining the fine particles through an active new surface generated by the deformation or fracture;

forming an anchor section made of polycrystalline brittle material of which part bites into the substrate surface at a boundary section between the new surface and a substrate; and

forming a structure made of the polycrystalline brittle material on the anchor section.

12. A composite structure forming method comprising, after performing a step of creating internal strain in brittle material fine particles, the steps of

providing the brittle material fine particles in which the internal strain has been created on a substrate surface;

applying mechanical impact force to the brittle material fine particles;

deforming or fracturing the brittle material fine particles by the impact;

rejoining fine particles through an active new surface generated by the deformation or fracture; and

forming an anchor section made of polycrystalline brittle material of which part bites into the substrate surface at a boundary section between the new surface and a substrate, and

forming a structure made of the polycrystalline brittle material on the anchor section at the same time.

13. The composite structure forming method according to claim 11 or claim 12, wherein the step of creating the internal strain in the brittle material fine particles is a step of imparting an impact to the fine particles to such a degree that re-cohesion is not caused.

14. The composite structure forming method according to claim 11 or claim 12, wherein the internal strain created by the step of applying the internal strain is in a range between 0.25% and 2.0%.

15. The composite structure forming method according to claim 11, wherein the average size of the brittle material fine particles after the step of creating the internal strain has been performed is 0.1 ~ 5 μm and the speed of the brittle material fine particles upon collision with the substrate is 50 ~ 450 m/S.

16. The composite structure forming method according to claim 11, wherein the average size of the brittle material fine particles after the step of creating the internal strain has been performed is 0.1 ~ 5 μm and the speed of the brittle material fine particles upon collision with the substrate is 150 ~ 400 m/S.

17. The composite structure forming method according to claims 11 through 16, wherein this forming method is performed at room temperature.

18. The composite structure forming method according to claim 11 or claim 12, wherein, after the structure made of the polycrystalline brittle material is formed, the structure is heated at a temperature lower than the melting point of the brittle material for structured control of the crystals.

19. The composite structure forming method according to claim 11 or claim 12, wherein this forming method is performed under reduced pressure.

20. The composite structure forming method according to claim 11, claim 15 or claim 16, wherein a means for causing the brittle material fine particles to collide with the substrate surface at high speed is to eject the aerosol containing scattered brittle material fine particles in the gas toward a substrate material at high speed.

21. The composite structure forming method according to claim 20, wherein the kind and/or partial pressure of the gas is controlled to control a deficiency of elements of a compound forming the structure made of the brittle material.

22. The composite structure forming method according to claim 20, wherein the partial pressure of oxygen in the gas is controlled to control the oxygen concentration in the structure made of the brittle material.

23. The composite structure forming method according to claim 20, wherein the partial pressure of oxygen in the gas is controlled using an oxide as the brittle material fine particles to form an oxygen deficient layer of the oxide near the boundary face of crystals in the structure made of the brittle material fine particles.

24. The composite structure forming method according to claim 20, wherein the kind and/or partial pressure of the gas is controlled to control electric properties, mechanical properties, chemical properties, optical properties and magnetic properties of the structure made of the brittle material.

25. The composite structure forming method according to claim 20, wherein the partial pressure of oxygen in the gas is controlled to control electrical properties, mechanical properties, chemical properties, optical properties and magnetic properties of the structure made of the brittle material.

26. Brittle material fine particles for forming a structure on a substrate surface are provided, which deform or fracture upon collision with a substrate or when a mechanical impact is imparted thereto and are provided with internal strain to generate an active new surface.

27. The brittle material fine particles according to claim 26, wherein the internal strain of the fine particles is 0.25% ~ 2.0%.

28. The brittle material fine particles according to claim 26, wherein the average size of the fine particles is 0.1 ~ 5 μm.

29. A composite structure is obtained, after performing a step of applying internal strain to brittle material fine particles, by the steps of:

causing the brittle material fine particles in which the internal strain has been created to collide with a substrate surface at high speed;

deforming or fracturing the brittle material fine particles by the impact of this collision;

rejoining the particles through an active new surface generated by deformation or fracture;

forming an anchor section made of polycrystalline materials of which part bites

into the substrate surface at a boundary section between the new surface and a substrate; and

forming a structure made of polycrystalline material on the anchor section.

30. A composite structure is obtained, after performing a step of creating internal strain in brittle material fine particles, by the steps of:

providing the brittle material fine particles in which the internal strain has been created on a substrate surface;

applying a mechanical impact force to the brittle material fine particles;

deforming or fracturing the brittle material fine particles by the impact;

rejoining the fine particles through an active new surface generated by this deformation or fracture; and

forming an anchor section made of polycrystalline materials of which part bites into the substrate surface at a boundary section between the new surface and a substrate, and

forming a structure made of the polycrystalline materials on the anchor section at the same time.

31. The composite structure according to claim 29 or claim 30, wherein the step of creating the internal strain in the brittle material fine particles is a step of imparting an impact to the fine particles to such a degree that re-cohesion is not caused.

32. The composite structure according to claim 29 or claim 30, wherein the internal strain resulting from the step of creating the internal strain is in a range between 0.25% and 2.0%.

33. The composite structure according to claim 29 or claim 30, wherein the average size of the brittle material fine particles after the step of creating the internal strain has been performed is 0.1 ~ 5 μm and the speed of the brittle material fine particles upon collision with the substrate is 50 ~ 450 m/S.

34. The composite structure according to claim 29 or claim 30, wherein the average size of the brittle material fine particles after the step of creating the internal strain has been performed is 0.1 ~ 5 μm and the speed of the brittle material fine

particles upon collision with the substrate is 150 ~ 400 m/S.

35. The composite structure according to claim 29 or claim 30, wherein the composite structure is formed at room temperature.

36. The composite structure according to claim 29 or claim 30, wherein after the structure made of the polycrystalline brittle material is formed, the structure is heated at a temperature lower than the melting point of the brittle material for structured control of the crystals.

37. The composite structure according to claim 29 or claim 30, wherein the composite structure is formed under reduced pressure.

38. The composite structure according to claim 29, claim 33 or claim 34, wherein a means for causing the brittle material fine particles to collide with the substrate surface at high speed is to eject the aerosol containing scattered brittle material fine particles in the gas toward the substrate material at high speed.

39. The composite structure according to claim 38, wherein the composite structure is obtained by controlling the kind and/or partial pressure of the gas and controlling a deficiency of elements of a compound forming the structure made of the brittle material.

40. The composite structure according to claim 38, wherein the composite structure is obtained by controlling the partial pressure of the oxygen in the gas and controlling the concentration of oxygen in the structure made of the brittle material.

41. The composite structure according to claim 38, wherein the composite structure is obtained by controlling the partial pressure of the oxygen in the gas using an oxide as the brittle material fine particles and by forming a deficient layer of oxygen of the oxide near the boundary face of the crystals in the structure made of the brittle material.

42. The composite structure according to claim 38, wherein the composite structure is obtained by controlling the kind and/or partial pressure of the gas and by controlling electric properties, mechanical properties, chemical properties, optical properties and magnetic properties of the structure made of the brittle material.

43. The composite structure according to claim 38, wherein the composite structure is obtained by controlling the partial pressure of the oxygen in the gas and by controlling electric properties, mechanical properties, chemical properties, optical properties and magnetic properties of the structure made of the brittle material.

44. A composite structure forming apparatus for ejecting and causing an aerosol generated by scattering brittle material fine particles in the gas to collide with a substrate at high speed to form a structure made of the brittle material is provided, which comprises an aerosol generator for generating the aerosol, a nozzle for ejecting the aerosol and a classifier for classifying the brittle material fine particles in the aerosol.

45. A composite structure forming apparatus for ejecting and causing an aerosol generated by scattering brittle material fine particles in the gas to collide with a substrate at high speed to form a structure made of the brittle material is provided, which comprises an aerosol generator for generating the aerosol, a nozzle for ejecting the aerosol, and a shredder for shredding cohesion of the brittle material fine particles in the aerosol (for shredding the brittle material fine particles cohering in the aerosol; or preventing cohesion of the brittle material fine particles in the aerosol).

46. A composite structure forming apparatus for ejecting and causing an aerosol generated by scattering brittle material fine particles in the gas to collide with a substrate at high speed to form a structure made of the brittle material fine particles is provided, which comprises an aerosol generator for generating the aerosol, a nozzle for ejecting the aerosol, a shredder for shredding cohesion of the brittle material fine particles in the aerosol (for shredding the brittle material fine particles cohering in the aerosol; or for preventing cohesion of the brittle material fine particles in the aerosol), and a classifier for classifying the brittle material fine particles in the aerosol.

47. The composite structure forming apparatus according to claims 44 through 46, wherein the composite structure forming apparatus is provided with a pretreatment device for creating internal strain in the brittle material fine particles.

48. The composite structure forming apparatus according to claims 44 through 47,

wherein the composite structure forming apparatus is provided with an impact imparting means for creating internal strain in the brittle material fine particles.

49. The composite structure forming apparatus according to claims 44 through 48, wherein the composite structure forming apparatus is provided with a position control means for controlling the position of the substrate relative to the nozzle.

50. The composite structure forming apparatus according to claim 49, wherein the position control means is a flexibly movable arm with the nozzle provided at the end of the arm.

51. The composite structure forming apparatus according to claims 44 through 50, wherein the aerosol generator comprises at least one of a container for containing the brittle material fine particles, a vibration device for imparting a mechanical vibration action to the container, and an electric field generating device for generating an electric field, wherein the container is provided with an introduction section for introducing the gas, and a guide section for guiding the aerosol outside.

52. The composite structure forming apparatus according to claim 51, wherein the classifier is the guide section of the aerosol generator.

53. The composite structure forming apparatus according to claim 51, wherein the container is provided with a sieve, and a vibration device is provided to impart a mechanical vibration action to the container.

54. The composite structure forming apparatus according to any one of claims 49 through 51 or claim 53, wherein the shredder is provided with an introduction section and a guide section for introducing and guiding the aerosol respectively, and an impact plate with which the aerosol collides, wherein the aerosol is caused to collide with the impact plate at a lower speed than that for forming the structure of the brittle material fine particles to shred the ultra fine particles which are in a coarse cohering condition.

55. The composite structure forming apparatus according to claim 50, wherein the shredder is provided with a plurality of introduction sections, and a plurality of aerosol streams ejected from these introduction sections is caused to collide with one another for shredding.

56. The composite structure forming apparatus according to claims 46 through 50 or claims 54 and 55, wherein the shredder is designed to apply ultrasonic waves and/or microwaves to the aerosol.